How individual variation in activity influences the transmission of novel information

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Introduction

Novel information allows individuals to obtain information about new food sources, predators, or other aspects of life.

Novel information can be acquired and transmitted throughout a group via social learning, which is the process of obtaining information based on observations of others, as opposed to direct sampling of the environment.

Previous models have neglected the fact that individuals will vary from others in their group in personality traits, such as exploration, or the propensity to move about their environment.

The purpose of our model was to determine if individual variation in movement propensity, or activity level, influences how quickly novel information is obtained by the entire group.

Hypothesis

If the individual starting out with novel information has a higher propensity for movement, then the entire group will obtain the novel information faster than if the starting individual has a lower propensity for movement.

Methods

The agent based model, Netlogo, was used to allow individuals to move around in an artificial environment.

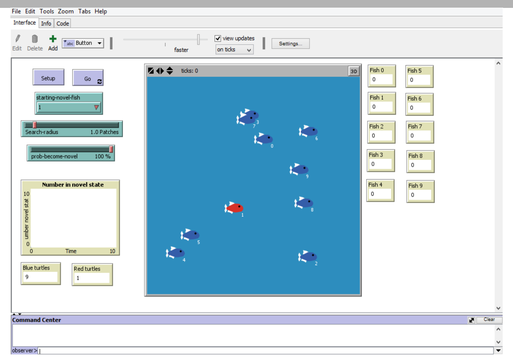
The probability each individual moved in a single time step, defined as the propensity to move, was varied to see how that influenced the speed at which novel information was transferred throughout the group.

We then compared the individual variation model to a model where all the agents had the same propensity for movement.

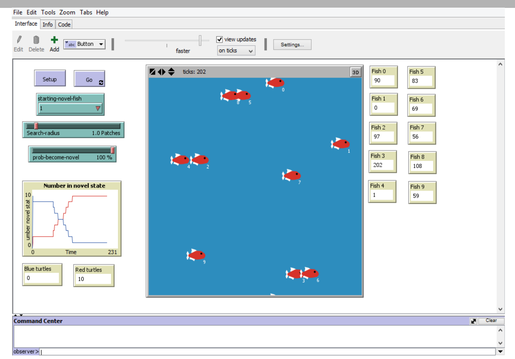
	Variation in Movement			No Variation in Movement
	Propensity for Movement			*Propensity for Movement*
Fish 0	0.1		Fish 0	0.5
Fish 1	0.2		Fish 1	0.5
Fish 2	0.3		Fish 2	0.5
Fish 3	0.4		Fish 3	0.5
Fish 4	0.5		Fish 4	0.5
Fish 5	0.6		Fish 5	0.5
Fish 6	0.7		Fish 6	0.5
Fish 7	0.8		Fish 7	0.5
Fish 8	0.9		Fish 8	0.5
Fish 9	1		Fish 9	0.5

As the agents interacted with each other over time, the novel information was passed to others in the group and the ending number of ticks was recorded as well as the number of ticks when half of the population had obtained the novel information.

Methods (cont.)



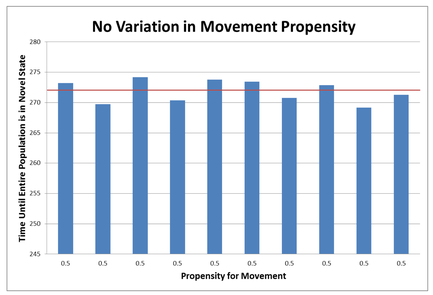
The beginning population started with a single individual with novel information, symbolized by the color red.



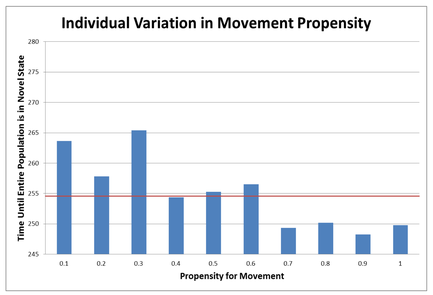
Eventually, all of the group obtained the novel information and the ending number of ticks was recorded.

Results

All of population has novel information

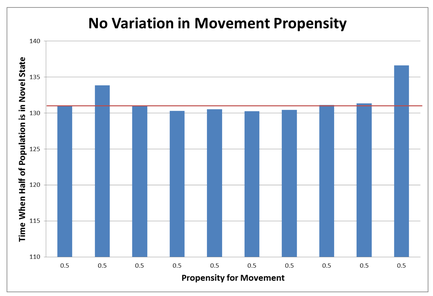


If all individuals have the same propensity for movement, for each individual who begins with the novel information, there is no difference in the number of time steps that it takes for the entire population to obtain the novel information.

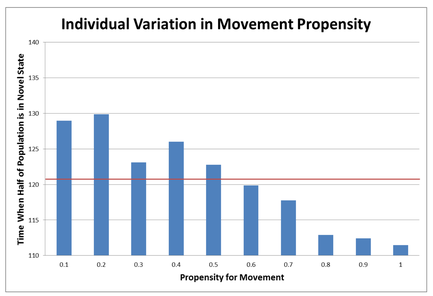


When there is individual variation in movement propensity, there is a difference in the time it takes for the entire population to obtain the novel information, depending on which individual started off with the novel information.

Half of population has novel information



If all individuals have the same propensity for movement, for each individual who begins with the novel information, there is no difference in the number of time steps that it takes for half of the population to obtain the novel information.



When there is individual variation in movement propensity, there is a difference in the time it takes for half the population to obtain the novel information, depending on which individual started off with the novel information.

Results (cont.)

A two-tailed Mann-Whitney U test was performed to analyze the difference between each model.

When there was individual variation in movement propensity, the whole population obtained the novel information faster than when there was no variation in movement propensity.
($U=0$, $p \leq 0.05$, $df=18$)

When there was individual variation in movement propensity, half of the population obtained the novel information faster than when there was no variation in movement propensity.
($U=0$, $p \leq 0.05$, $df=18$)

In models with individuals that started with novel information and had a higher propensity for movement, the entire population obtained the novel information faster than in models with starting individuals having a lower propensity for movement.

Conclusions

Propensity for movement, or activity level, influences the transmission of social information throughout a group.

The higher the propensity for movement of an individual with novel information, the faster that novel information will transmit throughout the entire group.

Future Models

Future models will examine how the probability an individual will transmit a novel piece of information to others in its group affects the rate at which the entire population acquires the novel trait.

We are also interested in how often different individuals in a population interact with each other and if this has an influence on the rate at which novel information is transmitted throughout the group.

Acknowledgements

This research was funded as part of the program, Research for Undergraduates: Adventures in Mathematical Biology and its Applications (RUMBA), which is supported by National Science Foundation UBM-Institutional Award DBI-0827256
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